# Fundus Reading Hood

University of Wisconsin-Madison
College of Engineering
BME 300
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***Abstract:***

***In the grading of retina scans at the Fundus Photograph Reading Center, normal office light interferes with the graders ability to efficiently identify lesions and other spots on the retina that are indicative of certain diseases. Since these lesions are often very small it is imperative to have a standard environment for these scans to be graded in. The design of a monitor hood that will induce this environment is the key element in obtaining accurate grading of retina scans.***

## §1. Problem Statement

The goal of this project is to develop a monitor hood that will block ambient light for the photograph graders at the Fundus Photograph Reading Center. Determining problematic sites in retinal scans is used to diagnose disease states in the eyes. A controlled environment is necessary for grading of these scans in order to assure correct identification of problematic sites. Creating a monitor hood will provide this controlled environment.

## §2. Background

The Fundus Reading Center is a facility located on the UW-Madison campus. The photograph reading center "strives to further the understanding and treatment of preventable blindness through interpretation of ophthalmic images in clinical studies" (eyephoto.ophth.wisc.edu).

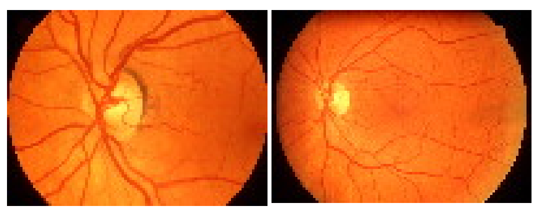

**Figure 1. Fundus Photographs**
**http://www.jhu.edu/wctb/coms/patient/photog/fundus.htm**

Photographs, like those in Figure 1, are received at the Reading Center and are graded for ophthalmic research. The focus of ophthalmic research at the Fundus Reading Center consists of five main categories: Diabetic Retinopathy, Age-related Macular Degeneration, Hypertensive Changes of the Retina, Studies of the Ocular Complications of AIDS (CMVR), and Age-related Eye Disease Study (AREDS). Since the retina can be assessed by noninvasive methods such as retinal photography, analyzing these photographs is preferred in relation to other invasive procedures. For example, retinal changes have been observed in many cases of hypertension and sclerosis.

When a patient is photographed, special cameras take images of the eye with the patient's pupil dilated. This procedure causes no discomfort to the patient and provides a photograph that details "the retina, the retinal vasculature, and the optic nerve head, optic disc from which the retinal vessels enter the eye." (www.jhu.edu)

The purpose of grading photographs at the Fundus Center is for retinal quality. This quality is important the viewing of arteriolar abnormalities and lesions of diabetic retinopathy. To insure quality of the photographs, there are many grading protocols for the readers to assess these ophthalmic images. (eyephoto.ophth.wisc.edu)

The stereoscope also plays a role in grading retinal images and must be accounted for in our design. Stereo images are pairs of photographs of the same subject. (stereo.thurstons.org) There are many techniques to view stereo images on the computer monitor such as parallel free vision and cross vision. (www.findarticles.com) However, the Fundus Reading Center uses a stereoscope to facilitate this process.

The purpose of viewing through a stereoscope is to view a pair of images as a single 3-D image. The stereoscope (Figure 2) is used by the grader while viewing the photographs. A lever on the side adjusts mirrors to converge the images. A horizontally-centered position is necessary for proper viewing of the ophthalmic images. The image will become more distorted the further from the center the stereoscope is positioned. The viewer may have to adjust and rotate from this horizontal position to attain stereo. There are two components that must be taken into consideration when viewing the images: the horizontal and vertical positions, as in a Cartesian grid. Horizontally, if that landmark is at the origin for one image but at a different level

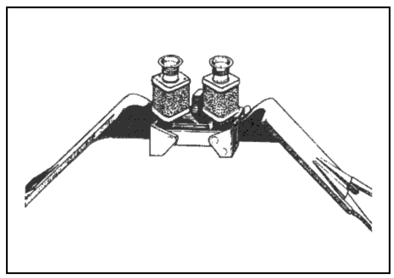

**Figure 2. A stereoscope similar to those used at the Fundus Reading Center**

vertically, turning your head can correct and re-align the images. Another problem occurs at the angle a person looks down at the screen; the eyes actually look down at a 30 degree angle. To correct this vertically, the monitor is positioned lower than the eyes and often tipped up slightly. (Hafford email)

The viewing of these images requires precision and accuracy of viewing conditions. Ambient light poses a problem. Problematic reflections on computer screens occur in two categories. The first category is with too much light falling on the screen. This type of reflection reduces contrast and washes out the image. The second category of reflections occurs from bright areas in the environment surrounding the computer monitor. These reflections superimpose on the screen image and make it hard to see. (www.pc.ibm.com)

## §3. Literature Search

A patent search reveals Patent 5,900,979, Patent 5,243,463, Patent D422,579, Patent 6,356,439, and Patent 6,394,615 which all describe monitor hoods for both laptops and desktop computers. Further information on these patents can be found in Table 1 in Appendix A. Related monitor hoods are available from companies such as ColorGear, CompUshade, Photodon, Ergomart, and Hoodman (Figure 3). These monitor hoods range from $25-$80. The goal of these devices is to reduce glare and background light. These products do not focus specifically on the reading of ophthalmic images or blocking all ambient light. An extended viewing window is also not part of their design.

**Figure 3. Photodon Monitor Hood (http://www.photodon.com/mgrh.htm)**

## §4. Design Constraints

The Fundus Reading Hood will be designed for LCD monitors and must block ambient so that the light intensity does not exceed 64 lux inside the hood. The design should be lightweight, sturdy, and self-supporting, with non-transparent fabric. The length must be adjustable and extend out 2 ft while keeping the monitor viewable at any length. While attached to the monitor, the design cannot extend significantly behind the monitor nor can it extend more than 15 inches in front of the monitor when not in use. The design must taper to a closed viewing port of approximately 8 1/4" by 2 3/8" with the viewing window approximately 5'' down from the top of the hood. Also, the hood should have an adjustable angle of view to allow the grader to maintain good posture. Most importantly, it should allow a clear view of the monitor at all times.

This design should be capable of operating in a regular, controlled office setting. No major safety issues exist; however, this device should comply with several International Ergonomics Association standards.

Additional design constraints are in the Product Design Specifications (Appendix C).

## §5. Alternative Designs

The rotating bar, solid interlocking panels, and accordion are the three design alternatives that will be discussed in detail. Also, advantages and disadvantages for each of these are addressed. The use of a design matrix (see Appendix B) will compare the differences in each design with respect to categories such as cost, flexibility, storage, ease of use and the design's ability to block ambient light.

## §5.1 Rotating Bar Design

The first design option, the rotating bar design, was proposed to address the issue of taking up visual space on the monitor. This design is composed of several main parts: the rotating metal framework, the fabric encasement, and the fabric front.

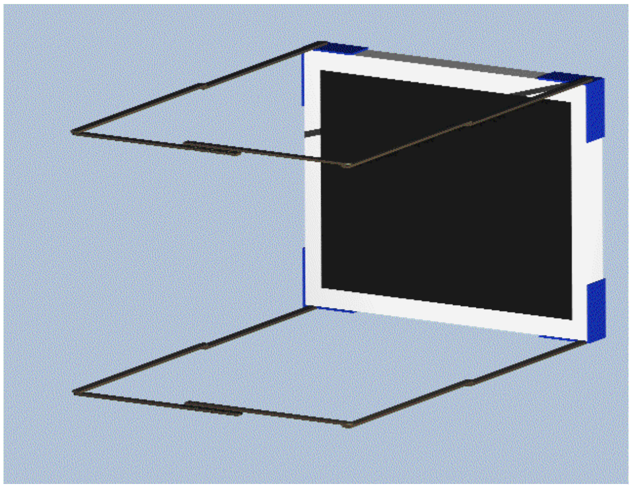

**Figure 4. Rods connect to the monitor corner brackets**

The metal framework consists of several aluminum bars that run about the length of the monitor (Figures 4 and 5). These bars can rotate 90 degrees out from the monitor. This would provide the main extension of the hood. Since the smallest monitor is 17 inches long and the bar cannot exceed this length, a secondary bar is fastened to the end of the primary bars allowing the required 24 inch extension. The secondary bars have the ability to rotate to 180° from the primary bar. Attached to the secondary bar would be a tertiary bar that rotates 90° from the secondary bar. Each tertiary bar would have three locking mechanism positions to lock to the bar across from it. This provides the lateral support linking the two top bar units and the two bottom bar units.

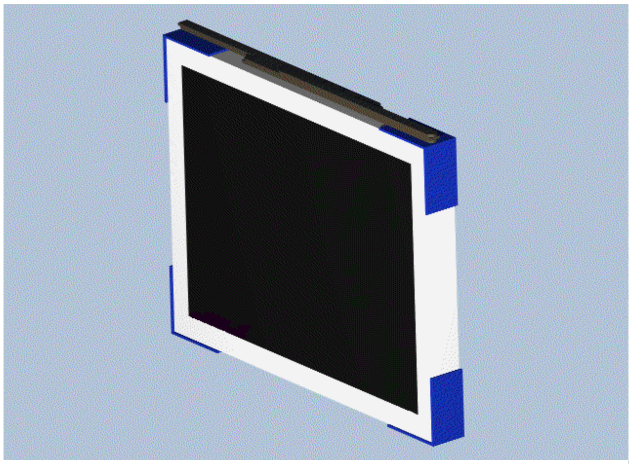

**Figure 5. Rods collapse to fit tightly to the monitor**

The fabric encasement in Figure 6 is made of a dark, solid material, like vinyl. It would be wrapped around the entire framework and accommodate the three different sizes of monitors by providing three locations of button snaps for where the encasement overlaps itself. This encasement would also provide the means to attach the fabric front.

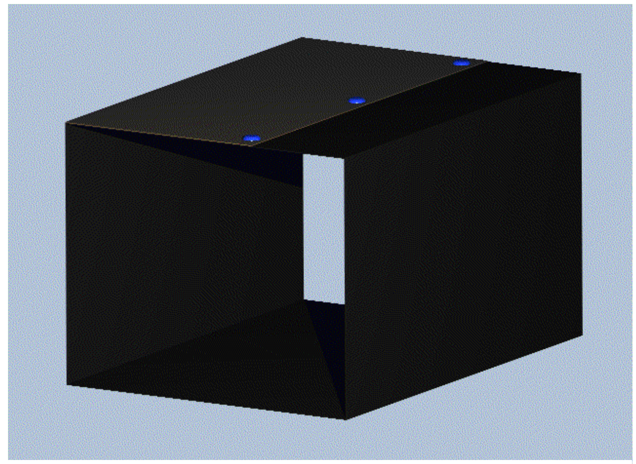

**Figure 6. Fabric encasement snaps over the rod framework**

The fabric front is designed to attach to the side encasement by several button snaps, each of which has multiple snaps for each size of monitor. The snaps are located on the tops and sides of the front, and extensions from the front that wrap around the corners. The center of the front panel will be open, to allow entry of the stereoscope viewer.

**Advantages and Disadvantages**

There are many advantages to this design. The manufacturing process would be fairly simple for the rods and brackets, because they could be made in the metals shop or bought. The fabric encasement is a simple pattern and would be easy to build. Along with the ease of manufacturing comes the lower projected cost. An estimated cost would include the fabrics, button snaps, and metal parts and be around 50 dollars. Storing the sections would be as simple as unsnapping the front panel, unsnapping the side encasements, unlocking the lateral bars, and rotating the bars inward to the monitor.

Disadvantages could include instability of the rod frame. It could become rickety after prolonged use, but if it is designed to be able to be screwed in tightly again, this problem will not be much of a hassle.

## §5.2 Solid Interlocking Panels Design

This design would involve the use, in part or in whole, of a solid frame and sides. A frame would be made that will fit any flat screen monitor (Figure 7). The frame would incorporate a mechanism to tighten and loosen the frame to accompany various monitor widths. Other than the adjustable width, the frame's design would allow it to simply rest over the monitor, using the weight of the hood to keep a tight seal against the viewing monitor.

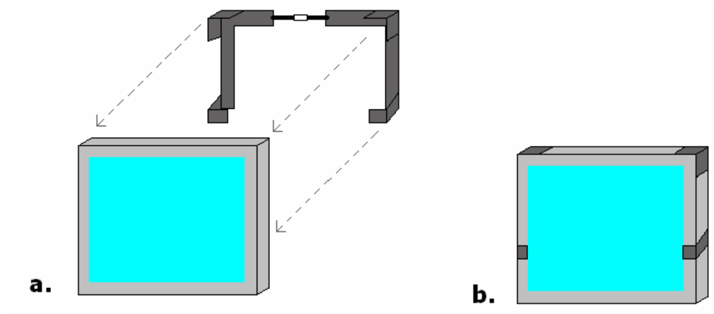


**Figure 7. a/b Frame seperate/attached to existing monitor**

The sides of the design can extend and collapse due to a track and rail assembly built in between the panels. The track and rail assembly may incorporate filing cabinet tracks, or possibly no moving parts at all, just sliding interlocking rails. These sides would be designed to block out light when fully extended.

The front plate with the stereoscope viewing window will be attached to one of the sides and will clip onto the other side when fully extended (Figure 8). Refinements to this would include a way to fix the stereoscope to the front plate while allowing full range of movement.

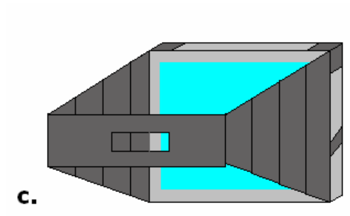


**Figure 8. c Fully extended sides with front plate attached**

The top and bottom coverings can be a hard material, but are currently represented as a cloth or vinyl with multiple sets of snaps to accommodate variations in monitor width (Figure 9: d/e). The multiple snaps would allow flexibility in extension length of the sides as well.

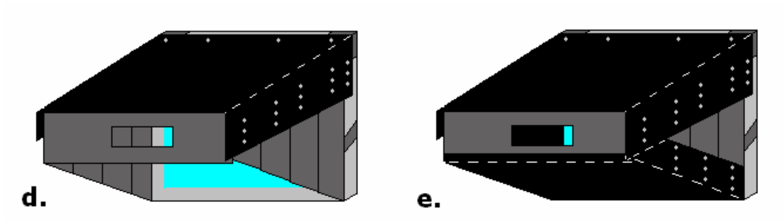


**Figure 9. d/e Cloth top and bottom attached to extended sides**

**Advantages and Disadvantages**

An advantage to this design is the sturdy construction due to rigid sides and front plate. The sides are easily adjustable for different monitor widths and have the ability to block out ambient light. Another advantage is the ease of use of this design, where setup just involves extending the sides and snapping on the top and bottom covering.

Disadvantages to this design involve a small footprint that would be left behind the monitor when the collapsible sides are folded back. Also, the solid front plate does not allow for the uninhibited movement of stereoscope that is necessary for grading the photographs. A solid frame may not fit correctly on thicker monitors even though the design would ideally accommodate all currently available monitors at Fundus. The snaps on tops and bottoms may be troublesome to work with when adjusting extension length of sides also. Finally, this design would be more costly than other alternatives and most likely more difficult to manufacture.

## §5.3 Accordion Design

The accordion design, which we have chosen as then final design, consists of three main components, the top hood, the main hood, and the retractable support devices.

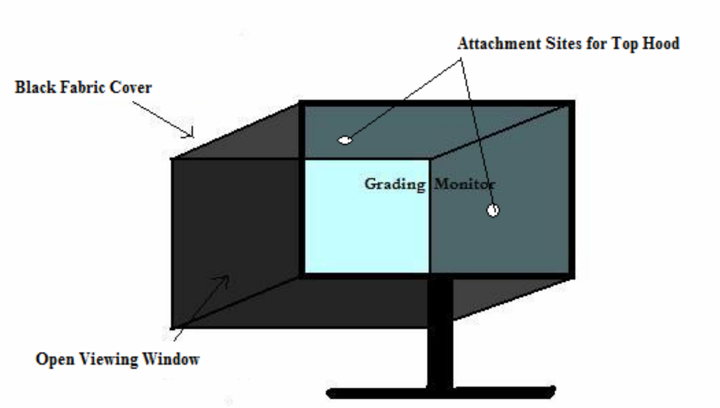


**Figure 10: Main hood on the grading monitor**

The main hood (Figure 10) is the primary component for blocking our ambient light. It will be constructed of a black fabric, much like vinyl. The main hood will be able to extend 24in and cover all four sides. On the four sides of the hood that face out there are attachment sites, or buttons, for attaching the top hood to the design.

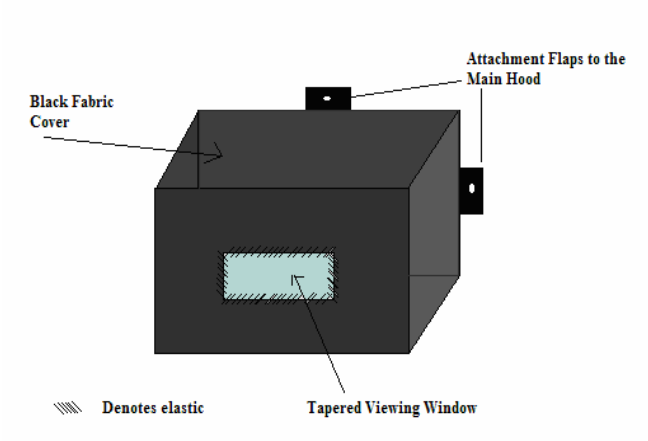


**Figure 11: Top hood**

The top hood (Figure 11) is required to meet the client requirement of the hood tapering to a closed viewing port of approximately 8 1/4" by 2 3/8". The perimeter of the viewing window is lined with elastic. This allows the stereoscope to fit snugly within the viewing window without allowing excess light to enter.

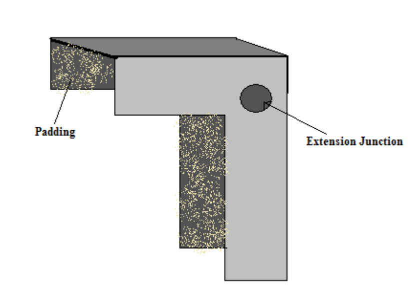


**Figure 12: Corner piece**

The main hood attaches directly to the grading monitor by metal corner pieces (Figure 12) at each corner of the monitor. The corner pieces are lined with a protective padding to prevent damage to the monitor. These corner pieces are attached to each other with thick elastic. This allows the design to accommodate varying monitor sizes. The corner pieces are also the base attachment point for the extension support devices.

These support devices (Figure 13) are attached to the main hood allowing the hood to contract when not in use and to be self supporting when fully extended. Another option of the contractible hood design concerns storage. Since the tapered viewing window is removable (a.k.a. the top hood), the device may be left on the monitor when not in use because it is contractible. However, if it is desired to have the hood removed from the monitor; the corner pieces can be stretched and taken off thanks to the elastic that connects them.

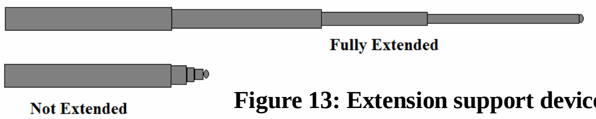

**Figure 13: Extension support device**

## Advantages and Disadvantages

This design allows flexibility in the range of monitors it can fit and in how it is stored. The elastic that attaches to each of the corner components allows the device to accommodate changes in monitor size insuring that the device remains useful even after several monitor upgrades. Also, when the device is no longer in use, it can either be contracted and left on the monitor or taken off and stored. If the device stays on the monitor the top hood needs to be removed and stored. Because the device is contractible, it should be able to stay on the monitor with little to no viewing obstruction.

Even though this device is flexible and may be left on the monitor, there may be problems in finding a storage space if taken off the monitor. On the other hand, taking the device off the monitor would add to the preparation time in using the device. Also, since there are two main hood components that need to be attached this may provide an opportunity for light to get through and also increases the amount of work that needs to be done to get the device ready for use.

## §6 Potential Problems

Potential problems lie ahead for our design team during the remainder of the semester. First, since our design has multiple components, complications in assembling these components could arise. For example, all material built must be accurate or the components will not fit properly during assembly. Also, obtaining the necessary materials in a timely fashion is required. Hood fabric type may also pose a problem. Inside the hood, there cannot be more than 64 lux of light intensity; this means our material used in this design needs to compensate for this requirement.  To address these problems, our team will research potential fabrics, do intensity tests for the potential hood fabrics, and draw up accurate design blue prints to help eliminate error in component assembly.

## §7 Future Work

Much work lies ahead in order to produce a prototype of this device. First, a meeting with the client is needed to obtain feedback about the proposed design. Client feedback and suggestions may result in subsequent changes to the design in order to satisfy new or over looked requirements.

Also, the team will discuss changes or integration of the other designs ideas to form a better final design. When a final design that satisfies all parties is determined, accurate scale drawings of the prototype will be developed. Research will also be done to determine the best fabric to be used for the different hood components. Following this, obtaining materials and construction of the prototype will begin. The goal is to have a viable prototype completed by the end of the semester.

## §8 References


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Appendix A

## Patent Descriptions

| U.S. Patent Number | Description |
|---|---|
| 5,900,979 | **A computer monitor hood**. Top, left side and right side shading panels, an elastic member or a spring member biases the left and right shading panels into frictional contact with said left and right side surfaces of the monitor. |
| 5,243,463 | **Visor for a video display terminal.** Left, right, and top wall with inner layers, granular or texturized for diffusing a part of the projected light beam in inner surface recesses |
| D422,579 | **Video Monitor hood** |
| 6,356,439 | **Glare reducing hood for a laptop computer monitor.** Made of a fabric closure structure attached to and supported by an endless frame member. |
| 6,394,615 | **A collapsible-light shield for a portable computer.** Four flexible panels that form a tubular shape, a ring-like elastic fastener that detachably secures to three sides of the computer display. |

Appendix B

# Design Martix

| Criteria | Rotating Bar Design | Solid Interlocking Panels Design | Accordion Design |
|---|---|---|---|
| **Ability to Block Light** | 3 | 3 | 3 |
| **Flexibility** | 4 | 4 | 5 |
| **Projected Cost** | 4 | 2 | 3 |
| **Ease of Storage** | 4 | 4 | 3 |
| **Ease of multiple Use for Client** | 2 | 4 | 3 |
| **Ease of Manufacturing** | 3.5 | 2 | 3.5 |
| **Total** | **20.5** | **19** | **20.5** |

*Scale: 1-5
1: Poor
3: Satisfactory
5: Outstanding

Each design proved to present an overall score of about 2/3 of the overall available points, but one design must be chosen to pursue.

Appendix C

# Fundus Reading Hood:
## *Project Design Specification (PDS)*

**Team Members:** Leah Brandon, Adam Dahlen, Nathan Kleinhans, Sara Worzella
**Client:** Dennis G. Hafford

**Last updated:** 10/12/05

**Function:** The goal of this project is to develop a flexible, easily stored monitor hood that will block ambient light. The monitor hood will be designed for LCD monitors used in grading retinal scans at the Fundus Reading Center.

**Client Requirements:**
The client requires the design to:

- Allow a clear view of the monitor at all times.
- Have an adjustable length of 24in.
- Be easily removable from the monitor or not extend out more than 15in. when not in use.
- Not to extend significantly behind the monitor.
- Take up a minimal amount of space when stored.
- Taper to a closed viewing port of approximately 8 1/4" by 2 3/8".
- Viewing port needs to be about 5in. down from the top of the monitor.
- Be self-supporting with no legs when extended.
- Have an adjustable angle of view to allow grader to maintain good posture.
- Be flexible to fit a range of monitor sizes.
- Light intensity under the hood should not exceed 64 lux

If time allows, the client also requests that the hood accommodate a fixture to secure a stereoscope to reduce fatigue from holding the accessory. The following specifications are required:

- 24 inches from the screen
- Horizontally-centered position
- Variable tracking
- Slight rotational ability

**1. Physical and Operational Characteristics**

a. ***Performance requirements***: The hood will be used on a regular basis, likely for several hours each day. However, since the monitor is used for other tasks the device must detach or retract to allow for complete viewing. The actual hood is not moving when it is in position, but changing positions will be estimated to occur at least 8 times per day.

b. ***Safety***: There will be very few safety concerns for the product. One minimal concern would be pinching of the fingers as mechanical folding occurs, but the forces will most likely not be strong enough to be dangerous, as the product will most likely be manually operated.

c. ***Accuracy and Reliability***:

- The device must accommodate flat screen monitors with a depth of about 1.5 inches
- Adjustment to each monitor type should be made.
    - Monitor dimensions to adhere to:
        - VP201b 17.5” W x 13.5” H x 1.5” D
        - FP2000 20.25” W x 16.75” H x 1.5” D
        - FP2001 17.5” W x 14” H x 1.25” D

d. ***Life in Service***: A likely product would be used for a number of years, possibly until the end of the client’s research. Travel, revolutions, and cycles do not apply.

e. ***Shelf Life***: Shelf life will be indefinite as long as it is kept in optimal conditions (cool, dry place) as to not promote rusting of mechanical joints.

f. ***Operating Environment***: Conditions of operation include those in a standard, air controlled, regular office setting:

- Normal room temperature operation (~70 degrees)
- Normal pressure ("the standard atmosphere" (1 atm) = 101.325 kilopascals)
- Low humidity
- Dirt and dust levels are low and negligible
- Fluid corrosion will not be a factor, as the office setting does not produce volatile fluid to affect the product
- Vibrations may cause loosening and detachment of the device from the computer monitor and should be kept to a minimum.

g. ***Ergonomics***: The device should be restricted to movement by manual force. It should have a small footprint (should not take up space behind the monitor) as there is very little room in many of the workspaces. The device should allow the monitor to be slightly below the eyes and angled up. If a ledge is attached to support the stereoscope it must pivot to allow the grader to maintain good posture.

h. ***Size***: Static components of the reading hood should not exceed 15-18 inches, but the total extension should reach 24 inches with no additional support. The unit must be collapsible to a very small size, leaving no footprint behind monitor.

i. ***Weight:*** Product weight must be minimal, as no legs can be attached for support. Computer monitors must bear all weight.

j. ***Materials:*** Frame must be light and sturdy; screen/fabric for the sides cannot be transparent to any degree.

k. ***Aesthetics***, ***Appearance, and Finish***: Ideally, a dark matte finish will be applied to all inner surfaces of hood to reduce or eliminate light reflection. Product is not required to be aesthetically pleasing, so long as functionality is maximized.

**2. Production Characteristics**

a. ***Quantity***: Roughly 15 units for all photograph graders at Fundus and the ability to easily manufacture more units if needed.

b***. Target Product Cost***: Optimal cost is under $200 a unit, however, budget allows for the prototype to cost no more than $2000.

**3. Miscellaneous**

a. ***Standards and Specifications***: This product is not regulated by the FDA but has several national standards. The applicable standards from the International Ergonomics Associations standards include ISO 3664, ISO 9241, ISO 9355, and ISO 14738. Theses standards address ergonomic requirements for office work with visual display terminals, for the design of displays and control actuators, and for safety of machinery, respectively.

b. ***Customer***: The customer would like a design that is lightweight, compact, and easily moved and stored in the lab. Previous designs presented to the client were too big, stationary, and heavy for the facility.

c. ***Patient-related concerns***: The privacy of patient data is a concern; however, the hood is offering further protection of privacy.

d. ***Competition***: Several monitor hoods exist on the market from companies such as ColorGear, CompUshade, Photodon, Ergomart, and Hoodman. These hoods sell from $25-$80, a lower price range than our reading hood. U.S. patents for monitor hoods and similar coverings are 5,900,979, ***5,243,463*** D422,579, 6,356,439 6,394,615 The purpose of these monitor hoods is to reduce glare and background light. None of these products focus specifically on the reading of ophthalmic images or blocking all ambient light. Also, they do not include an extended viewing window